USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note — 34

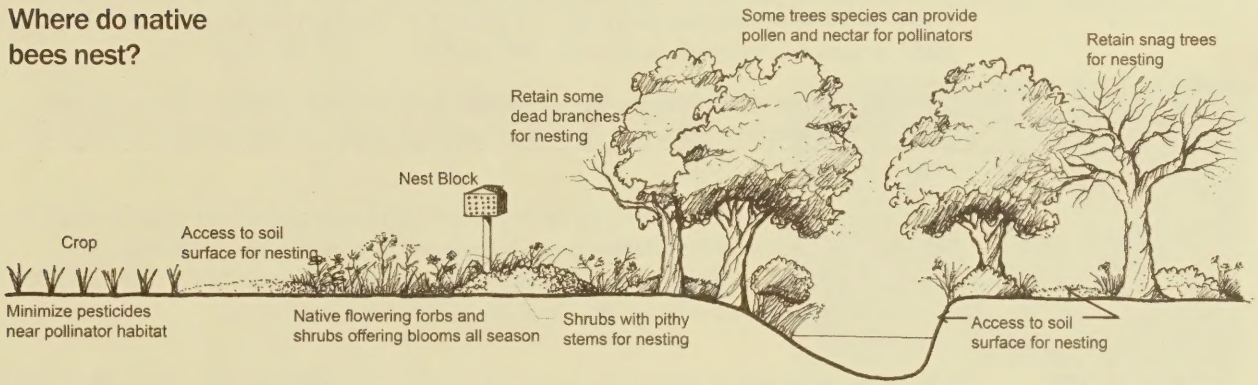
February 2007

Enhancing Nest Sites For Native Bee Crop Pollinators

Introduction

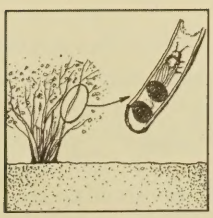
The European honey bee receives most of the credit for crop pollination, but the number of managed honey bee hives is half of what it was in the 1950s; and this number continues to decline primarily because of honey bee pests and diseases. Native bees, however, contribute significantly to crop pollination and, on farms with sufficient natural habitat located nearby, may even provide all of the required pollination for some crops. In order to support the native bee community, it is essential to provide nesting sites in addition to floral resources. Unfortunately, intensively managed farm landscapes often lack the untilled ground, tree snags, plants, and small cavities that native bees require for nest construction. Agroforestry practices can provide essential nesting habitat for bees, our most important crop pollinators.

Where do native bees nest?



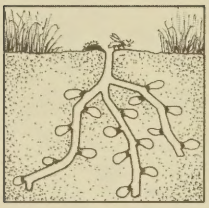
Most native bees nest underground in areas that are sunny, well-drained, and either bare or partly vegetated. Alternatively, they nest in narrow tunnels in wood, or small cavities such as abandoned rodent nests. *USDA National Agroforestry Center illustration.*

Native bees have very different nesting requirements from the more familiar European honey bee (introduced from Europe in the early 1600s). Unlike the large comb-filled hives of a honey bee colony, they are generally solitary species, with each female constructing and provisioning the nest by herself. Only when adults emerge from their hidden nests do we see them flying about pollinating crops and other plants. The rest of the year they are tucked away inside the cells of their underground or plant-tunnel nests. Most solitary bees are active as adults for only a few weeks each year and most have only a single annual generation. An exception are some social sweat bees that can have several overlapping generations through the summer. These sweat bees are the most abundant native bees in some studies of crop pollination and build large populations over the summer growing season.



Solitary wood nesting bees

About 30 percent of our 4,000 native bee species are solitary wood-nesters that build their nests inside hollow tunnels. These tunnels may occur in the soft pithy centers of some twigs (e.g. box elder, elderberry, or various cane berries); they may be left behind by wood-boring beetle larvae or, in the case of carpenter bees, may be excavated by the bees themselves. Another small but important set of bee species – at least one of which has been documented as an important pollinator of watermelon – tunnel into soft, above-ground rotting logs and stumps.



Solitary ground nesting bees

Most (about 70 percent) of our native bee species excavate their nests underground. These ground nesting native bees all burrow narrow tunnels down to small chambers (the brood cells) six to 36-plus inches under the surface. Inside these brood cells next year's bees develop. In order to build these nests, bees need *direct access* to the soil surface, often on sloped or well-drained sites.

Bumble bees

The remaining bees – only about 45 species in the US – are social bumble bees. Bumble bees are frequently our most effective crop pollinators. They construct nests in small cavities, often in old rodent burrows, either underground or beneath fallen plant matter, or occasionally above ground in abandoned bird nests. Queen bumble bees start new nests each spring and by mid-summer their colonies can have dozens or hundreds of workers, all visiting nearby flowers. For this reason, doing what you can to encourage bumble bee nest sites in agroforestry practices can go a long way towards supporting crops that flower during summer months.

Agroforestry and nest sites

All agroforestry plantings can provide excellent nesting opportunities for native bees. Therefore, the easiest approach to supporting native bees in a landscape is to look for potential nesting areas and then protect them as best as possible. Specifically:

- **Retain dead or dying trees and branches whenever it is safe and practical.** Wood-boring beetle larvae often fill dead trees and branches with narrow tunnels into which tunnel-nesting bees will move. In addition, retain rotting logs where some bee species may burrow tunnels in which to nest.
- **Protect sloped or well-drained ground sites where plants are sparse and direct access to soil is available.** These are the areas where ground nesting bees may dig nests. Native bee nests have been found in orchards, front yards, along farm roads, and even in cultivated fields.
- **Leave some areas of the farm untilled and minimize weed control tillage.** Turning the soil destroys all ground nests that are present at that depth and hinders the emergence of bees that are nesting deeper in the ground.
- **Protect grassy thickets, or other areas of dense, low cover from mowing or other disturbance.** These are the sites where bumble bees might find the nest cavities they need, not to mention biennial or perennial forbs that can provide significant food resources (see *Agroforestry Note* 33: Improving forage for native bee crop pollinators).

Enhancing nest sites in the field

The following active management techniques may be employed to further increase nesting opportunities.

Solitary wood nesting bees

- Using a hand drill and a variety of drill bit sizes (from 3/32" (3 mm) to 5/16" (9 mm)), drill holes as deep as possible into downed dry wood sections. Erect the section upright like a fence post to simulate a beetle-tunneled snag. A variety of hole diameters will support a variety of different sized bee species. Face the holes south as much as possible.
- Using the same drill and bits, drill holes in stumps or standing dead wood, so long as the wood is not rotting or saturated with water. Angle the holes slightly upward to reduce water entry.
- Plant shrubs or other plants that have pithy stems. Every year, cut back some of the new growth to expose the pithy interior of the stems. Elderberry, boxelder, blackberries or raspberries (*Rubus* spp.), sumac, or dogwood are all good choices.

Solitary ground nesting bees

The precise conditions – soil type, soil texture, degree of compaction and moisture retention – needed by most ground-nesting bees is not well known. However, the methods below could support a variety of species. Colonization of these nest sites will depend upon the bees already present in the area, their successful reproduction and population growth, and the suitability of other nearby sites.

- Wherever possible, avoid turning over soil. Bees need stable soil, and their progeny spend up to

eleven months of the year underground. The more surface area left untilled, the more likely bees will find and colonize appropriate nest sites.

- Clear some of the vegetation from a gently sloping or flat area. The goal is to remove thatch, making it easier for bees to access the soil below but still leaving some clumps of grass or other low-growing plants to prevent erosion. The site should be well drained, in an open, sunny place, and, preferably, on a south-facing slope. Different ground conditions – from vertical banks to flat ground – will draw different bee species, so create a variety of partially bare patches and observe which ones best attract ground-nesting bees.

Bumble bees
Studies indicate that bumble bees often occupy the grassy interface between open fields and hedgerows or woods. This has been attributed to the presence of abandoned rodent nests in which bumble bees nest. Areas of habitat suitable for bumble bees should include a mix of native grasses and forbs abutting shrubs or trees. The grass area needs to be at least five feet wide and mowed only every two or three years. Always mow in the late fall or winter, after the colonies have died for the year and when queens are dormant.

Building nests for the field

Solitary wood nesting bees
Tunnel nesters will use a variety of structures that mimic beetle holes in wood or the centers of pithy stems. Simply drill holes in blocks of wood, or tie a bundle of paper straws or hollow stems together. Include a range of hole sizes to attract a variety of different bees who are active at different times in the year. Mount these blocks with tunnels horizontal in a location that receives morning sun, but has some protection from rain and the extremes of midday sun and heat in the summer. Generally, erect nests at least four feet above the ground.

Solitary ground nesting bees
Create a stable pile of soil, at least two feet high, perhaps after excavating ditches or ponds, or grading fields. Different species of bees nest in different soil types, but the soil should be at least 35 percent sand. If necessary, contain the pile with walls of lumber or bricks. Experiment by creating piles with different soil mixtures or by placing piles in locations that receive different amounts of sun.

Bumble bees
Bumble bees may move into small boxes (cubes 7 inches on a side) packed lightly with upholsters' cotton. Note that even under the best conditions, only about 5 to 25 percent of nest boxes may become colonized.

Don't worry if native bees nest close to homes. Solitary bees are gentle and very reluctant to sting. Bumble bees are not aggressive unless their nests are exposed or they are harassed. If we respect their needs, they will ignore us. *Photo by Matthew Shepherd, Xerces Society.*

For more detailed instructions to construct an artificial nest visit the Xerces Society website: *www.xerces.org* or order the *Pollinator Conservation Handbook.*

Other considerations

Besides the basic nest structures or features needed by native bees, a few other resources are important for successful nesting.

- First, different bee species – particularly tunnel-nesting solitary bees – need various materials to construct their brood cells and seal their nests. A few bees secrete a cellophane-like substance to protect their brood cells, but most use gathered materials, such as pieces of leaf or flower petals, mud, fine pebbles, or tree resins. Most likely these materials are already present, but providing a diversity of native plants and protecting areas with damp clay will help.

- Second, bumble bee queens need protected sites in which to overwinter. These often occur in the soft humus, leaf litter, or other sites protected from extreme winter weather into which they can burrow.

- Finally, a bee's nest is a home base from which to scour the surrounding lands[illegible] pollen. It is important to provide all of the nectar and pollen that bees need (see *Agroforestry Note* 33). The closer nest sites are located to pollen and nectar sources, the less energy female bees need to spend commuting back and forth, and the more resources they can put into their offspring. As a result, they will produce more offspring, and grow their populations over time. In addition, if nest sites are located close to abundant nectar and pollen (within 250 meters), the bees are less likely to forage where they may encounter insecticides or other hazards that are outside of a grower's control.

Additional information

AF Note – 32: Agroforestry: Sustaining Native Bee Habitat For Crop Pollination. M. Vaughan and S. Black. 2006. USDA National Agroforestry Center.

AF Note – 33: Improving Forage For Native Bee Crop Pollinators. M. Vaughan and S. Black. 2006. USDA National Agroforestry Center.

Farming for Bees: Guidelines for Providing Native Bee Habitat on Farms. M. Vaughan, M. Shepherd, C. Kremen, and S. Black. 2004. Xerces Society. 34 pp. *www.xerces.org/Pollinator_Insect_Conservation/Farm_Pollinator_Guidelines.pdf*

How to Manage the Blue Orchard Bee As an Orchard Pollinator. J. Bosch and W. Kemp. 2001. The National Outreach Arm of USDA–SARE, Handbook Series, Book 5. Sustainable Agriculture Network, National Agricultural Library, Beltsville, MD. 88 pp.

Pollinator Conservation Handbook. M. Shepherd, S. Buchmann, M. Vaughan and S. Black. 2003. The Xerces Society. Portland, OR. 145 pp.

The Biology and External Morphology of Bees. W.P. Stephen, G.E. Bohart, and P.F. Torchio. 1969. Oregon State University Agricultural Experiment Station. Corvallis, OR. 140 pp. *http://ir.library.oregonstate.edu/dspace/handle/1957/2080.*

Xerces Society Pollinator Program, *www.xerces.org/Pollinator_Insect_Conservation/*

Logan Bee Lab website: *www.ars.usda.gov/Main/site_main.htm?modecode=54-28-05-00* (Click on the "research" button and look for links to nest blocks and stick nests).

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